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A new species of *Ancistrolepis* (Gastropoda: Buccinidae) from the Iwaki Formation (lower Oligocene) of the Joban coal field, northern Japan

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Abstract. ***Ancistrolepis* (*Ancistrolepis*) *iwakiensis* sp. nov. from the lower Oligocene of the Joban coal field, northern Japan closely resembles both *Ancistrolepis* (*A.*) *matchgarensis* (Makiyama) from the upper Eocene to Oligocene of Sakhalin and *Ancistrolepis* (*A.*) *rategiensis* Titova from the upper Eocene of northwestern Kamchatka. *A.* (s. s.) *iwakiensis* sp. nov. documents an early evolutional history of *Ancistrolepis* (s. s.) that appeared in the northwestern Pacific during late Eocene time.**

Key words: ***Ancistrolepis*, early Oligocene, Gastropoda, northwestern Pacific**

Introduction

The Ancistrolepidinae is one of the most common groups of the gastropod family Buccinidae: it occurs in shallow to deep waters in the boreal and arctic regions. Unlike some other buccinids, the fossil and living species of Ancistrolepidinae have a restricted distribution, being found only in the northern Pacific. The systematics of the subfamily is still not clearly understood (Amano *et al.*, 1996).

According to Egorov and Barsukov (1994), who studied the living species of Ancistrolepidinae, the subfamily contains six genera: *Ancistrolepis* (with three subgenera: *Ancistrolepis* (s.s.), *Bathyancistrolepis*, and *Clinopegma*), *Pseudoliomesus*, *Neancistrolepis*, *Sulcosinus*, *Japelion*, and *Parancistrolepis*. The species of *Ancistrolepis* (s.s.) live at present in lower sublittoral to bathyal waters (100 to 690 m) around Honshu, Hokkaido, Sakhalin, and Kamchatka (Higo and Goto, 1993). In addition, *Ancistrolepis* (*A.*) *vietnamensis* Sirenko and Goryachev has been recorded at depths from 400 to 700 m in the South China Sea (Egorov and Barsukov, 1994).

Titova (1993) discussed the evolution of the fossil Ancistrolepidinae in the northern Pacific, and adopted the systematics of Ancistrolepidinae as follows: *Ancistrolepis* (with *Ancistrolepis* (s.s.), *Bathyancistrolepis*, and *Clinopegma*), *Neancistrolepis*, and *Pseudoliomesus*. She suggested that *Ancistrolepis* (s.s.) appeared in the northwestern Pacific (northern Japan to Kamchatka) during the late Eocene. However, the Paleogene Ancistrolepidinae are rather scarce in the northern Pacific. Matsui (1958) described the earliest representatives of Ancistrolepidinae in Japan from the Urahoro and Ombetsu Groups (upper Eocene to lower Oligocene) of the Kushiro coal field, eastern Hokkaido, placing the species in *Neptunea*. These species are here referred as *Ancistrolepis* (*A.*) *huruhatai* (Matsui), *A.* (*A.*) *subcarinatus* (Matsui), and *A.* (*Bathyancistrolepis*) *sitakaraensis* (Matsui). Honda (1989) also originally described *Ancistrolepis* (*A.*) *ogasawarai* as a *Neptunea* from the Charo Formation (lower Oligocene) of the Ombetsu Group. In addition, *Ancistrolepis* (*A.*) *modestoideus* (Takeda) has been recorded from the Poronai Formation (upper Eocene to lowermost lower Oligocene) of the Ishikari coal field, central Hokkaido, and the Urahoro and Ombetsu Groups (Takeda, 1953; Matsui, 1958; Honda, 1989).

The southernmost area yielding Paleogene *Ancistrolepis* (s.s.) is located in the Joban coal field, northeastern Honshu, northern Japan (Figure 1). Only two poorly preserved specimens of *Ancistrolepis* (s.s.) have been recorded from the lower Oligocene of the Joban coal field. They are *Ancistrolepis* sp. cf. *A.* (*A.*) *subcarinatus* (as *Neptunea ezoana* Takeda; Kamada, 1962, p. 166, pl. 20, fig. 19) from the Iwaki Formation and *Ancistrolepis* (*A.*) sp. (as *A. yamanei* Kanehara, 1937, p. 13, pl. 4, fig. 8, in part) from the Asagai Formation (Titova, 1993).

Yanagisawa *et al.* (1989) studied the subsurface litho- and biostratigraphy of the Cenozoic strata in the Futaba area of the Joban coal field (Figure 1). Their drill core A-1 yielded numerous well-preserved molluscan fossils at seven horizons of the Iwaki (IW-1-3) and Asagai (AS-1-4) Formations (Figure 2). The mollusks include *Acila* (*Truncacila*) *oyamadensis* Hirayama, *Cyclocardia laxata* (Yokoyama), *Clinocardium asagaiense* (Makiyama), *Papyridea* (*Profulvia*) *harrimani* Dall, *Mya* sp., and *Turritella* sp. (Yanagisawa *et al.*, 1989). In this paper, I describe a new species of

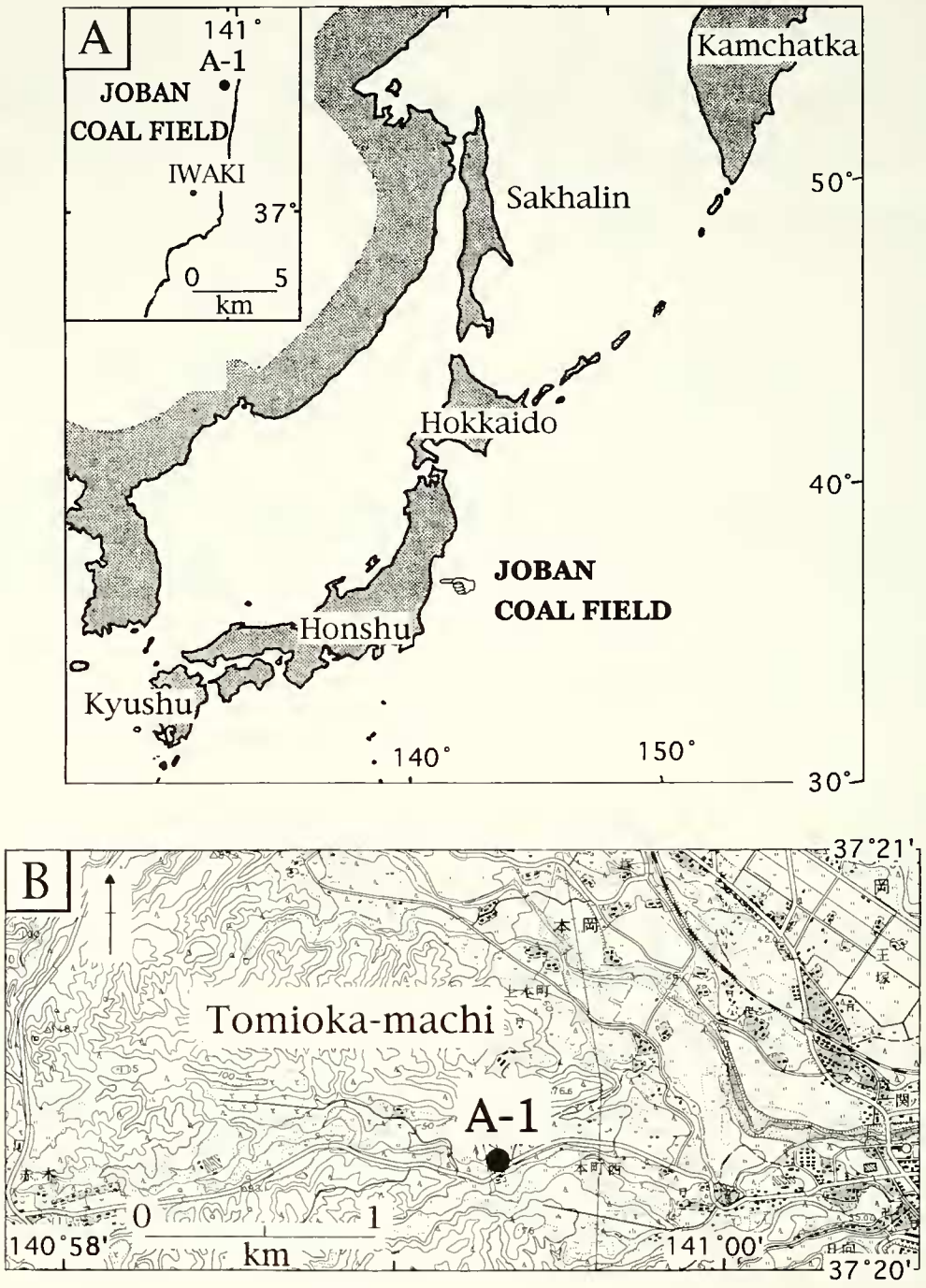

Figure 1. **A**. Map of the northwestern Pacific showing the location of the Joban coal field and place names referred to in the text. **B**. Map of the Joban coal field showing the location of drill core A-1 (parts of 1:25,000 scale maps, "Iwaki-Tomioka" and "Yonomori" published by the Geographical Survey of Japan).

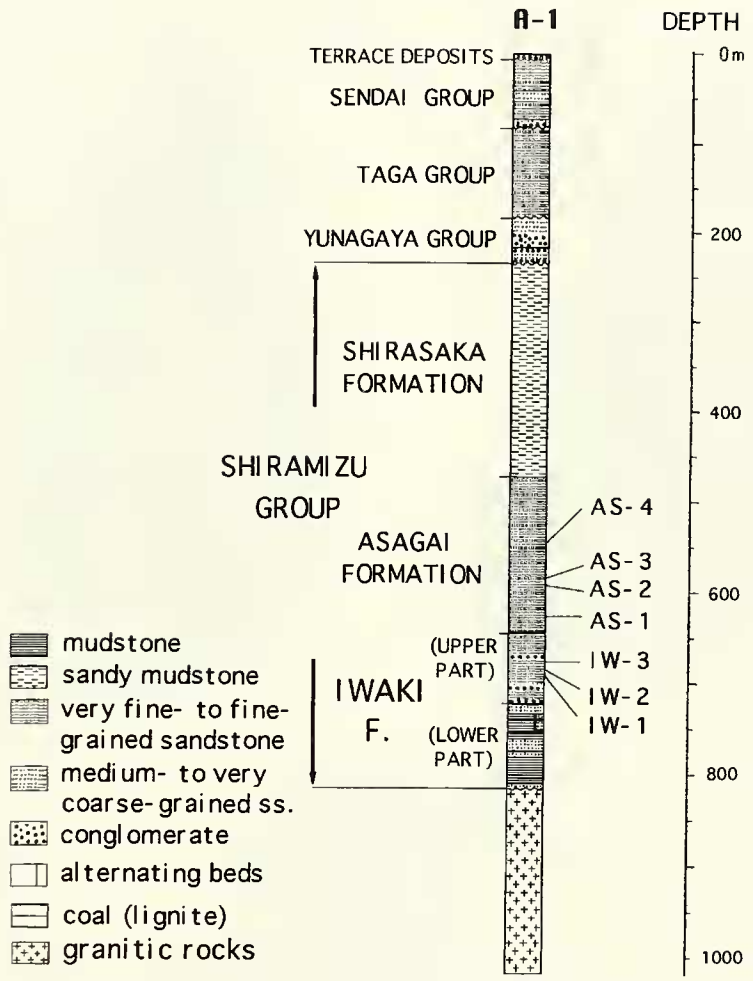

Figure 2. Columnar section of drill core A-1 (compiled from Yanagisawa *et al.*, 1989; Kubo *et al.*, 1994). IW-1-3, AS-1-4; fossil horizons.

Ancistrolepis (s.s.) obtained from the horizon IW-3 of the Iwaki Formation in drill core A-1.

Geological setting

Drill core A-1 of Yanagisawa *et al.* (1989) is lithologically divided into six units, which are, in ascending order, the basement granitic rocks (pre-Tertiary), the Shiramizu (lower Oligocene), Yunagaya (lower Miocene) and Taga (middle to upper Miocene) Groups, the upper part of the Sendai Group (upper Pliocene), and terrace deposits (Pleistocene) (Yanagisawa *et al.*, 1989, Kubo *et al.*, 1994; Figure 2).

The Shiramizu Group is further divided into the Iwaki, Asagai, and Shirasaka Formations, in ascending order (Figure 2). The lower part of the Iwaki Formation consists largely of mudstone with intercalating arkose, fine- to medium-grained sandstone, coal seams, and coaly mudstone. The upper part of the formation is composed of silty, very fine- to fine-grained sandstone with intercalated fine- to medium-grained sandstone and coal seams (Yanagisawa *et al.*, 1989). The Asagai Formation is made up of massive, very fine- to fine-grained sandstone with small carbonaceous fragments. The Shirasaka Formation consists of grey sandy mudstone (Yanagisawa *et al.*, 1989).

Tomida (1986) dated the Iwaki Formation as early Oligocene by the occurrence of the mammalian fossil *Entelodon*. Using fossil diatoms and silicoflagellates, Yanagisawa *et al.* (1989) also dated the Shirasaka Formation as early Oligocene. Consequently, the Shiramizu Group as a whole should be attributed to the lower Oligocene (Yanagisawa *et al.*, 1989).

Description of new species

Family Buccinidae Rafinesque, 1815
Subfamily Ancistrolepidinae Habe and Sato, 1972
Genus ***Ancistrolepis*** Dall, 1895
Subgenus ***Ancistrolepis*** s.s.

Type species.—*Chrysodomus eucosmius* Dall, 1891

Ancistrolepis* (*Ancistrolepis*) *iwakiensis sp. nov.

Figure 3

Neptunea sp., indet. Yanagisawa *et al.*, 1989, pl. 12, fig. 6.

Type locality.—At a depth of 675.00 to 675.20 m in drill core A-1 (GSJ B326), along a tributary of the Tomioka-gawa, Honcho-nishi, Tomioka-machi, Futaba-gun, Fukushima Prefecture, Japan (Lat. 37°20′16″N, Long. 140°59′20″E; Figure 1B).

Holotype.—GSJF15135 (Figure 3) in the Geological Museum, Geological Survey of Japan, Tsukuba, Japan.

Etymology.—The name is derived from the formation name "Iwaki."

Material.—One specimen (holotype GSJF15135).

Diagnosis.—Shell moderate in size and fusiform. Spire high, with five whorls. Surface sculptured with three (four on penultimate whorls) subrounded spiral cords. Each interspace occupied by one fine cord.

Description.—Shell moderate in size, rather thin, and fusiform. Whorls five in number, and divided by moderately incised suture. Whorl profile moderately convex with rounded shoulder. Surface sculptured with spiral cords, which intersect feeble growth lines. Three spiral cords on upper whorls, four on fourth (penultimate) whorl, equally spaced, subrounded, and narrower than interspaces. Each interspace on third to forth whorls occupied by one fine cord. Four spiral cords on upper part of body whorl, subrounded, and narrower than interspaces. More than six spiral cords on lower part, very low, subrounded, and much broader than interspaces. Each interspace on upper part of body whorl occupied by one fine cord.

Measurements.—Holotype, GSJF15135, height 56.5 mm+, diameter 34.7 mm, pleural angle 36°.

Horizon.—IW-3, upper part of the Iwaki Formation (Figure 2). Lower Oligocene.

Associated fauna.—The new species is associated with *Clinocardium asagaiense* (Yanagisawa *et al.*, 1989).

Remarks.—One rather well-preserved, nearly complete specimen, with pale brown shell material, was obtained from the greenish-grey, fine-grained sandstone of the upper part of the Iwaki Formation. The specimen largely lacks the siphonal area, because the core diameter is limited to approximately 60 mm. The features of the siphonal area are therefore not observable.

The new species resembles *Ancistrolepis* (*A.*) *matchgarensis* (Makiyama, 1934) from the Matchigar Formation (upper Eocene to Oligocene; Barinov and Gladenkov, 1998) of northern Sakhalin and the Arakai Formation (Oligocene) of southern Sakhalin (Titova, 1993). *Ancistrolepis matchgarensis* has only three primary cords, however, the new species has both three or four primary cords and one secondary cord. Titova (1993, p. 12, figs. 2A-D) described *Ancistrolepis* (*A.*) *rategiensis* from the Rategian Formation (upper Eocene) of northwestern Kamchatka. The present new species differs from *A. rategiensis* in having more broadly rounded spiral cords. *Ancistrolepis iwakiensis* sp. nov. also differs from *A.* (*A.*) sp. (=*Ancistrolepis yamanei* Kanehara, 1937, p. 13, pl. 4, fig. 8, in part; see Titova, 1993) from the Asagai Formation in having a less convex whorl profile and a fine cord between the spiral cords.

Discussion

The genus *Ancistrolepis* (s.s.) is the earliest representative of the Ancistrolepidinae, which probably originated from a common ancestor with the *Neptunea altispirata* group (Titova, 1993). *N. altispirata* was originally described by Nagao (1928) from the Doshi Formation (upper Eocene to lowermost lower Oligocene Funazuan stage; Honda, 1994) of Kyushu, southern Japan. *N. altispirata* has also been recorded from the upper Eocene of western Kamchatka (Gladenkov *et al.*, 1991). The *N. altispirata* group includes *N. onbetsuensis* Matsui from the Omagari and Charo Formations (uppermost upper Eocene to lower Oligocene) of the Kushiro coal field, eastern Hokkaido, and *Neptunea vinjukovi* Krishtofovich from the Oligocene of northern Sakhalin (Titova, 1993). The new species is similar to species of the *N. altispirata* group in having a rather moderately elevated spire.

Honda (1991, 1994) noted that several cold-water genera such as *Neptunea*, *Clinocardium*, and *Mya* appeared from tropical or subtropical ones of Japan and Sakhalin from late middle Eocene to early Oligocene time. Titova (1993) also noted that *Ancistrolepis* (s.s.) appeared in the region of northern Japan to Kamchatka during late Eocene time. These four genera originated in the northwestern Pacific, probably concurrent with the Eocene-Oligocene transition to a global cooling trend.

Titova (1993) divided *Ancistrolepis* (s.s.) into the *Ancistrolepis eucosmius* and *A. grammatus* stocks. The *A. eucosmius* stock is characterized by having a smaller shell, less numerous and weaker radial cords than the *A. grammatus* stock. Accordingly, the new species belongs to the *A. grammatus* stock based on general features of the shell. Titova (1993) further subdivided the *A. eucosmius* stock from the late Eocene to early Miocene into three groups. These are: 1) the *Ancistrolepis huruhatai-A. subcarinatus* group from the upper Eocene and lower Oligocene of Hokkaido and northern Honshu; 2) the *Ancistrolepis rategiensis-A. matchgarensis* group from the upper Eocene and Oligocene of northern Honshu, Hokkaido, Sakhalin, and Kamchatka; and 3) the group of *Ancistrolepis clarki* Tegland and *A. rearensis* (Clark) from the Oligocene and lower Miocene of Northwest America, which probably evolved from *A. rategiensis*. The *A. huruhatai-A. subcarinatus* group is characterized by well-developed secondary spiral cords (Titova, 1993). The new species has only one secondary cord, so it belongs to the *A. rategiensis-A. matchgarensis* group of Titova (1993).

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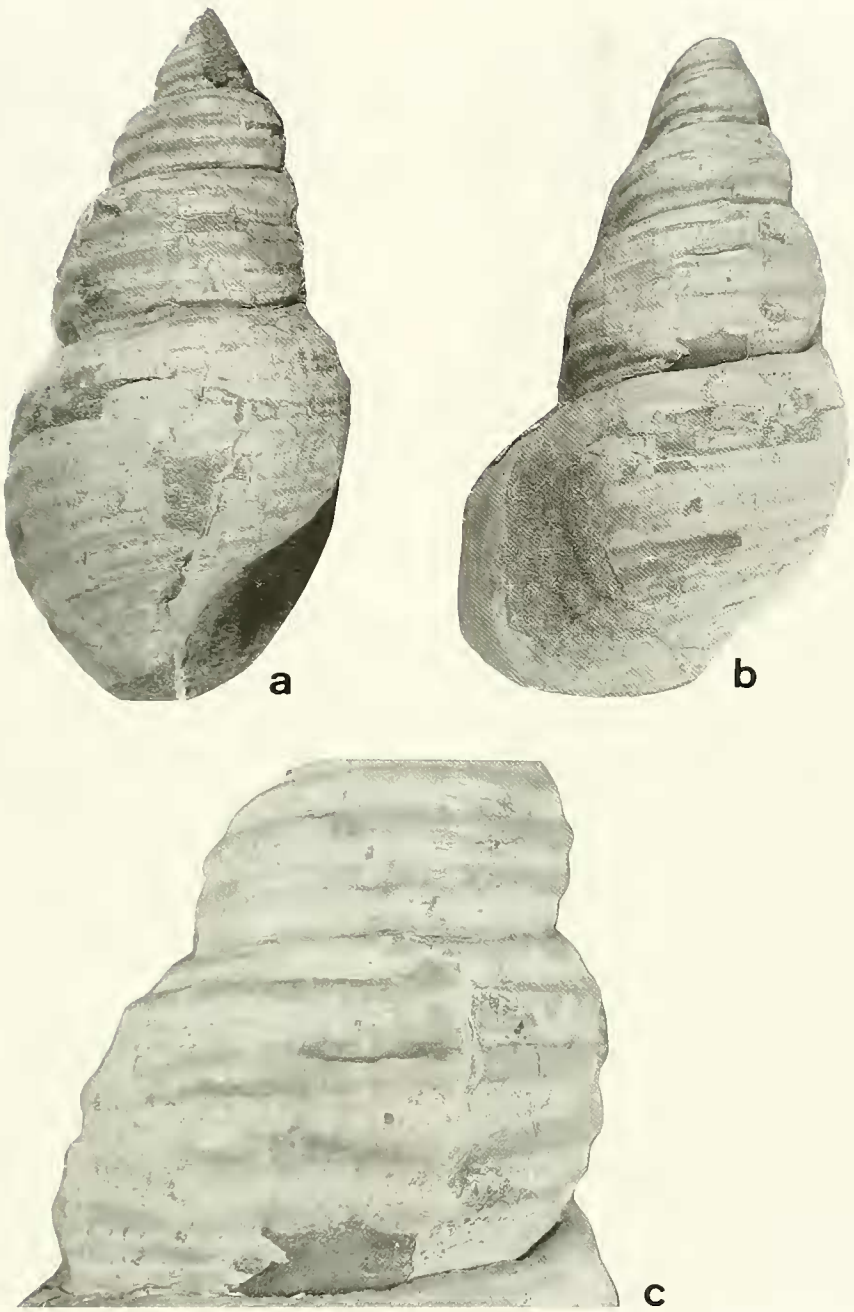

Figure 3. *Ancistrolepis* (*Ancistrolepis*) *iwakiensis* sp. nov., Horizon IW-3, Holotype, GSJF15135. **a**. Apertural-backside view, ×1.5. **b**. Backside view, × 1.5. **c**. Close-up of the third to fourth (penultimate) whorls, × 3.1. GSJ; Geological Museum, Geological Survey of Japan, Tsukuba, Japan.

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